

The Time Value of Money

In order to work the problems in this module, the user should have the use of a financial calculator such as the Hewlett-Packard 17BII.

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If you have any comments or suggestions on how to improve this presentation, please e-mail the author at surgery@tdn.net.

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11. *Applied to 433 cases*

• **James Smith** **My Suburbanite's Prayer**

$\mathcal{L} = \mathcal{L}_{\text{preprocess}} + \mathcal{L}_{\text{postprocess}}$

Figure 10.10

Fundamentals of Financial Management, 10/e

Chapter 3

Future Value (Graphic)

If you invested \$2,000 today in an account that pays 6% interest, with interest compounded annually, how much will be in the account at the end of two years if there are no withdrawals?

0 6% 1 2

\$2,000 FV

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Future Value (Formula)

$$FV_1 = PV(1+i)^n = \$2,000(1.06)^2 = \$2,247.20$$

FV = future value, its value at some future point in time
 PV = present value, a value today which is usually designated as time 0
 i = rate of interest per compounding period
 n = number of compounding periods

Calculator keystrokes: 1.06 (2nd y^x) 2 x 2000 =

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Future Value (HP 17 B II Calculator)

Exit until you get Fin Menu.
 2nd, Clear Data
 Choose FV, then TVM

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Future Value Example

John wants to know how large his \$5,000 deposit will become at an annual compound interest rate of 8% at the end of 5 years.

0 8% 1 2 3 4 5

\$5,000 FV₅

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Future Value Solution

Calculation based on general formula: $FV_n = PV(1+i)^n$
 $FV_5 = \$5,000(1 + 0.08)^5$
 $= \$7,346.64$

Calculator keystrokes: 1.08 2nd y^x 5000 =

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Future Value (HP 17 B II Calculator)

Exit until you get Fin Menu.
 2nd, Clear Data,
 Choose FV, then TVM

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Chapter 3

Double Your Money!!!

Quick: How long does it take to double \$5,000 at a compound rate of 12% per year (approx.)?

We will use the "Rule-of-72".

The "Rule-of-72"

Quick: How long does it take to double \$5,000 at a compound rate of 12% per year (approx.)?

Approx. Years to Double = $72 / i$

$72 / 12 = 6 \text{ Years}$
(Actual Time is 6.12 Years)

Present Value

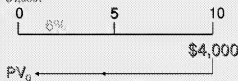
Since $FV = PV(1+i)^n$

$$PV = FV / (1+i)^n$$

Discounting is the process of translating a future value or a set of future cash flows into a present value.

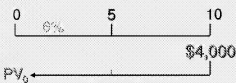
Present Value (Graphic)

Assume that you need to have exactly \$4,000 saved 10 years from now. How much must you deposit today in an account that pays 6% interest, compounded annually, so that you reach your goal of \$4,000?



Present Value (Formula)

$$PV_0 = FV / (1+i)^t = \$4,000 / (1.06)^{10} = \$2,233.58$$



Present Value (HP 17 B II Calculator)



Wait until you get Pmt Memo
2nd, Clear Data,
Choose F01, then TVM

2 nd	F01
2 nd	CEC
2 nd	CLR
2 nd	CLR

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Chapter 3

Present Value Example

Joann needs to know how large a deposit to make today so that the money will grow to \$2,500 in 5 years. Assume today's deposit will grow at a compound rate of 4% annually.



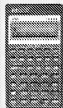
Present Value Solution

Calculation based on general formula:
 $PV_0 = FV_n / (1+i)^n$
 $PV_0 = \$2,500 / (1.04)^5$
 $= \$2,054.81$

Calculator keystrokes: 1.04 2nd y^x 5 =
 2nd 1/x X 2500 =

Present Value (HP 17 B II Calculator)

Exit until you get Fin Menu.
 2nd. Clear Data
 Choose Fin, then TVM



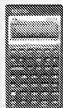
5	N
4	I/Y
2500	FV
0	PV
0	PMT
0	END

Finding "n" or "i" when one knows PV and FV

If one invests \$2,000 today and has accumulated \$2,676.45 after exactly five years, what rate of annual compound interest was earned?

(HP 17 B II Calculator)

Exit until you get Fin Menu.
 2nd. Clear Data
 Choose Fin, then TVM



5	N
0	I/Y
2000	PV
2676.45	FV
0	PMT
0	END

Frequency of Compounding

General Formula:

$$FV_n = PV_0 [1 + (i/n)]^{n \cdot m}$$

n: Number of Years

m: Compounding Periods per Year

i: Annual Interest Rate

FV_n : FV at the end of Year n

PV_0 : PV of the Cash Flow today

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Chapter 3

Frequency of Compounding Example

Suppose you deposit \$1,000 in an account that pays 12% interest, compounded quarterly. How much will be in the account after eight years if there are no withdrawals?

$$PV = \$1,000$$

$$i = 12\%/4 = 3\% \text{ per quarter}$$

$$n = 8 \times 4 = 32 \text{ quarters}$$

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13-10: Frequency of Compounding

Solution based on formula:

$$\begin{aligned} FV &= PV (1 + i)^n \\ &= 1,000(1.03)^{32} \\ &= 2,575.10 \end{aligned}$$

Calculator Keystrokes:

$$1.03 \text{ 2nd } y^x 32 \times 1000 =$$

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13-11: Frequency of Compounding

Future Value, Frequency of Compounding (HP 17 B II Calculator)



Beit until you get Fin Menu.
2nd, Clear Data
Choose FV, then TVM

1	1000
2	3
3	32
4	3
5	32

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13-12: Frequency of Compounding

Annuities

An **Annuity** represents a series of equal payments (or receipts) occurring over a specified number of equidistant periods.

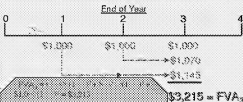
Examples of Annuities Include:

- Student Loan Payments
- Car Loan Payments
- Insurance Premiums
- Mortgage Payments
- Retirement Savings

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13-13: Frequency of Compounding

Example of an Ordinary Annuity -- FVA



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13-14: Frequency of Compounding

Future Value (HP 17 B II Calculator)



Beit until you get Fin Menu.
2nd, Clear Data,
Choose FV, then TVM

1	1000
2	3
3	32
4	3
5	32

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13-15: Frequency of Compounding

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Chapter 3

Example of an Ordinary Annuity -- PVA

Timeline diagram showing cash flows at the end of years 1, 2, and 3, each being \$1,000. The present value (PVA) is calculated as \$2,924.32.

$PVA = \$1,000 \times \frac{1 - (1 + 0.05)^{-3}}{0.05} = \$2,924.32$
 (Using a financial calculator: $N=3, I/Y=5, PMT=1000, FV=0$, solve for PV .)

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Present Value (HP 17 B II Calculator)

Enter what you get for the Money.
 2nd, Clear Data
 Choose P/Y, then TVM

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Multiple Cash Flows Example

Suppose an investment promises a cash flow of \$500 in one year, \$600 at the end of two years and \$10,700 at the end of the third year. If the discount rate is 5%, what is the value of this investment today?

Timeline diagram showing cash flows at the end of years 1, 2, and 3, each being \$500, \$600, and \$10,700. The present value (PV₀) is calculated as \$10,263.47.

Source: 10/e, 2007. © 2007 Pearson Education, Inc.

Multiple Cash Flow Solution

Timeline diagram showing cash flows at the end of years 1, 2, and 3, each being \$500, \$600, and \$10,700. The present value (PV₀) is calculated as \$10,263.47.

$PV_0 = \$476.19 + \$544.22 + \$9,243.06 = \$10,263.47$
 (Using a financial calculator: $N=1, I/Y=5, PMT=500, FV=0$, solve for PV ; $N=2, I/Y=5, PMT=600, FV=0$, solve for PV ; $N=3, I/Y=5, PMT=10700, FV=0$, solve for PV .)

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Multiple Cash Flow Solution (HP 17 B II Calculator)

Enter what you get for the Money.
 2nd, Clear Data.

Source: 10/e, 2007. © 2007 Pearson Education, Inc.

Bond Valuation Problem

Find today's value of a coupon bond with a maturity value of \$1,000 and a coupon rate of 6%. The bond will mature exactly ten years from today, and interest is paid semi-annually. Assume the discount rate used to value the bond is 8.00% because that is your required rate of return on an investment such as this.

Interest = \$30 every six months for 20 periods
 Interest rate = $8\% / 2 = 4\%$ every six months

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Chapter 3

Bond Valuation Solution (HP 17 B II Calculator)


Each month you get \$10 Mmm.

7th, Clear Data

P/YR	12
FV/FD	1000
N	36
I/YR	7
PMT	-10
END	YES
OK	OK
OK	OK



PV = 1000.00



t = 0 1 2 ... 36

↓ 1000 ↑ 10 ↑ 10 ... ↑ 10 ↑ 10 ↑ 10

← 10 × 36 = 360 →

\$1000.00

[illegible]

Problem #1

You must decide between \$25,000 in cash today or \$30,000 in cash to be received two years from now. If you can earn 8% interest on your investments, which is the better deal?

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11. Analysis of Options

Possible Answers - Problem 1

1. \$25,000 in cash today

2. \$20,000 in cash to be received two years from now

3. Either option O.K.

Need a Hint?

© 2000 TIAA

15 *Investment 101*

Solution (HP 17 B II Calculator)

Problem #1

HPB wants to get Pin Mann.
2nd C, Clear Data
Clears FIN, then TVM

1	2	3
4	5	6
7	8	9
0	10	11
12	13	14
15	16	17
18	19	20
21	22	23
24	25	26
27	28	29
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423	424	425
426	427	428
429	430	431
432	433	434
435	436	437
438	439	440
441	442	443

Problem #2

What is the value of \$100 per year for four years, with the first cash flow one year from today, if one is earning 5% interest, compounded annually? Find the value of these cash flows four years from today.

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Chapter 3

Possible Answers - Problem 2

☐ \$400
☐ \$411.01
☐ \$452.85

Need a Hint?

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Solution (HP 17 B II Calculator)

Problem #2

Hit until you get Fin Menu
2nd, Clear Data
Choose FIN, then TVM

N	4
I/Y	8
PV	100
FV	100
PMT	4
END	

$$EVA = 100(1.08)^4 + 100(1.05)^4 + 100(1.05)^4$$

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Problem #3

What is today's value of a \$1,000 face value bond with a 5% coupon rate (interest is paid semi-annually) which has three years remaining to maturity. The bond is priced to yield 8%.

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Possible Solutions - Problem 3

☐ \$1,000
☐ \$971.87
☐ \$1,021.37

Need a Hint?

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Solution (HP 17 B II Calculator)

Problem #3

Hit until you get Fin Menu
2nd, Clear Data

N	6
I/Y	8
PV	1000
FV	1000
PMT	25
END	

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Congratulations!

You obviously understand this material.
 Now try the next problem.

The Interactive Exercises are found on slide #37.

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Chapter 3

Comparing PV to FV

Remember, both quantities must be present value amounts or both quantities must be future value amounts in order to be compared.

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13.1.1 (part of a presentation)

How to solve a time value of money problem.

- The “value four years from today” is a future value amount.
- The “expected cash flows of \$100 per year for four years” refers to an annuity of \$100.
- Since it is a future value problem and there is an annuity, you need to solve for a FUTURE VALUE OF AN ANNUITY.

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13.1.2 (part of a presentation)

Valuing a Bond

- The interest payments represent an annuity and you must find the present value of the annuity.
- The maturity value represents a future value amount and you must find the present value of this single amount.
- Since the interest is paid semi-annually, discount at HALF the required rate of return (4%) and TWICE the number of years to maturity (6 periods).

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13.1.3 (part of a presentation)